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CHECKLIST OF *SPHAGNUM* IN NEW HAMPSHIRE

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ABSTRACT. Forty-three species and two subspecies of *Sphagnum* are reported for New Hampshire, including fifteen species and one subspecies documented from herbarium records and recent collections. Diversity at county and biophysical subsection (ecoregion) levels is presented and areas that remain undercollected in the state are highlighted. New Hampshire has a great diversity of *Sphagnum* species, reflecting the diversity of climatic, geologic, and environmental characteristics of the state. Several species with restricted distributions are discussed, and habitats critical to these species are described for future conservation efforts.

Key Words: *Sphagnum*, New Hampshire

The distribution of sphagna in New Hampshire can be interpreted in terms of the particular phytogeographic and habitat affinities of each species. In general, plant species with alpine, boreal, montane, eastern deciduous forest, and coastal plain affinities are all well represented in New Hampshire (Sperduto 1996; Weatherbee and Crow 1990). Plant assemblages in the state reflect not only these broad-scale climate-driven phytogeographic affinities, but also finer scale differences in hydrologic and nutrient regimes (Sperduto 1997, 2000). Peatlands are frequent within the mosaic of upland acidic forests on till (e.g., spruce–

fir, northern hardwood, and transitional hardwood–conifer forests). The dominant peatlands are open and acidic. Despite the predominance of acidic conditions, circumneutral to calcareous communities are well represented in smaller patches, including calcareous fens and swamps. In sum, 43 wetland types have been described from New Hampshire (Sperduto 1996).

Sphagnum is found as a minor component in many of New Hampshire's wetland community types. Peat mosses achieve greatest importance and diversity in four wetland systems in the state: open bogs, open fens, forested basin swamps, and forested seepage swamps. These systems include 13 of the 43 wetland types based on characteristic vegetation and environmental conditions (Sperduto 1997, 2000). Peatland types range from alpine to coastal and from acidic to calcareous. This checklist is the first to include collection sites representing all wetland types present in the state.

Prior to the present study, D. C. Eaton and E. Faxon made the most concerted effort to document *Sphagnum* species in New Hampshire. Eaton and Faxon collected *Sphagnum* in the northern counties of Coös and Grafton in the 1880s and 1890s (Reid 1987). The results were published in two exsiccatae: North American Sphagna (N.A.S.) collected by E. Faxon and Sphagna Boreali-Americana (S.B.A.) collected by D. C. Eaton and E. Faxon. Fifty-six of the 172 numbered specimens in S.B.A. were collected in New Hampshire. William G. Farlow was also an important early collector of *Sphagnum* in the state. More recent collections include those of A. R. Hodgdon in the 1950s and 1960s from Strafford and Carroll counties and Holcombe (1979), who reported the first New Hampshire collection of *S. angermanicum* from Ethan Pond in the White Mountains.

There are only two previous lists that include New Hampshire *Sphagnum* species. The first is Sphagnaceae of New England reporting 27 species (Andrews 1906) and the second is a preliminary list of New Hampshire mosses that includes five *Sphagnum* species (Allen 1992). Together these lists report 29 species for the state. The general scarcity of collections and their concentration in the White Mountain area has resulted in a severe lack of documentation for the majority of the state.

The purposes of this paper are: 1) to present a checklist for *Sphagnum* species in New Hampshire based on herbarium specimen annotations and field collections (Appendix); 2) to discuss

currently known species distributions and habitat restrictions within the state; and 3) to highlight current and potential threats to the diverse *Sphagnum* flora of New Hampshire.

MATERIALS AND METHODS

New Hampshire spans 290 km of latitude and an elevation range from sea level to 1912 m at the summit of Mount Washington, the highest point in northeastern North America. On average, the state's climate is cool-temperate, with extreme local variation. Average annual temperatures range from 5 to 7.8°C throughout most of the state; however, the average annual temperature is −3°C on Mount Washington. July temperatures average 18.9 to 21°C while January temperatures average −5.2 to −9.1°C. Precipitation is fairly evenly distributed throughout the seasons. Total annual precipitation varies from 104 to 112 cm across most of the state, with a high of 178 cm on Mount Washington. Annual average snowfall varies from 127 cm on the coast to 165 to 178 cm inland and 470 cm on Mount Washington. Length of the growing season varies from less than 105 days in the north to 140 days in the south. Eighty-three percent of the state is still covered by forest. New Hampshire ranks 47th out of 50 states in wetland area. Ninety-three percent of the original wetland areas are still in existence (Dahl 1990).

The checklist is based on both herbarium and recently collected specimens (see Appendix). All *Sphagnum* specimens from New Hampshire located at BING, BH, and NHA were examined, as well as selected specimens from NY, FH, and YU. In addition, over 1500 collections were made by the authors from 86 wetland sites. Field collections were initiated in 1994, largely at the A. Le Roy Andrews Foray. During this foray several coastal plain wetland sites were collected including the Ponemah bog and fen system, Hampstead Atlantic white cedar swamp, Dead Pond in Pawtuckaway State Park, and Spruce Pond at Bear Brook State Park. In 1999, the A. Le Roy Andrews Foray was held again in New Hampshire and selected collections by Andrus from sites in Carroll County are included here. Through 1994 and 1995, Cleavitt conducted bryophyte surveys of the Hubbard Brook Experimental Forest (Cleavitt and Fahey 1996) and six Research Natural Areas (RNAs) within the White Mountain National Forest (Cleavitt 1996). Sperduto and Nichols collected *Sphagnum* during state-

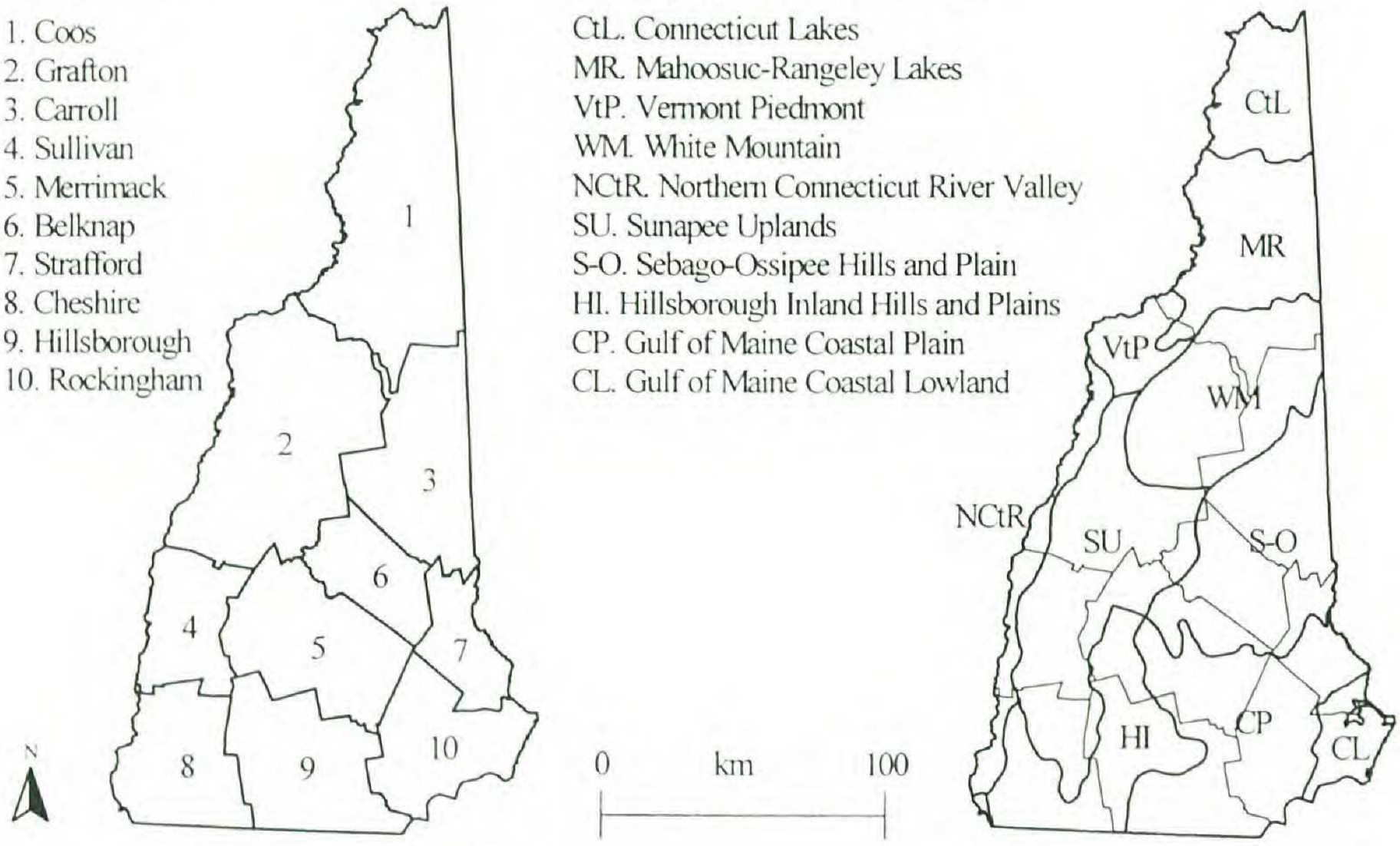

Figure 1. Maps of New Hampshire showing a. county boundaries, and b. biophysical subsections (heavy lines) in relation to county boundaries (fine lines).

wide wetland surveys during the years 1994–1998 and 1997–1998. United States Department of Agriculture Forest Service ecoregion subsections (Keys and Carpenter 1995) and vegetation units (Sperduto 1997, 2000) within the state were used to help direct field work and identify potential information gaps.

Sphagnum species are reported in a conventional manner according to county distribution (Figure 1a) and based on ten biophysical subsections (ecoregions) defined by the U.S. Forest Service (Keys and Carpenter 1995; Figure 1b). Subsections represent landscape-level units within the state that share similar assemblages of physiography, vegetation, soils, and climate, and are used here since they relate more closely to the distribution of vegetation types in the state than do politically based counties. Nomenclature follows Anderson (1990) except for *S. brevifolium* (Flatberg 1992b), *S. majus* subsp. *norvegicum* (Flatberg 1987), and *S. viride* (Crosby et al. 1999).

RESULTS

Examination of herbarium material revealed 233 unicate specimens representing 51 county and 4 state records not recorded by

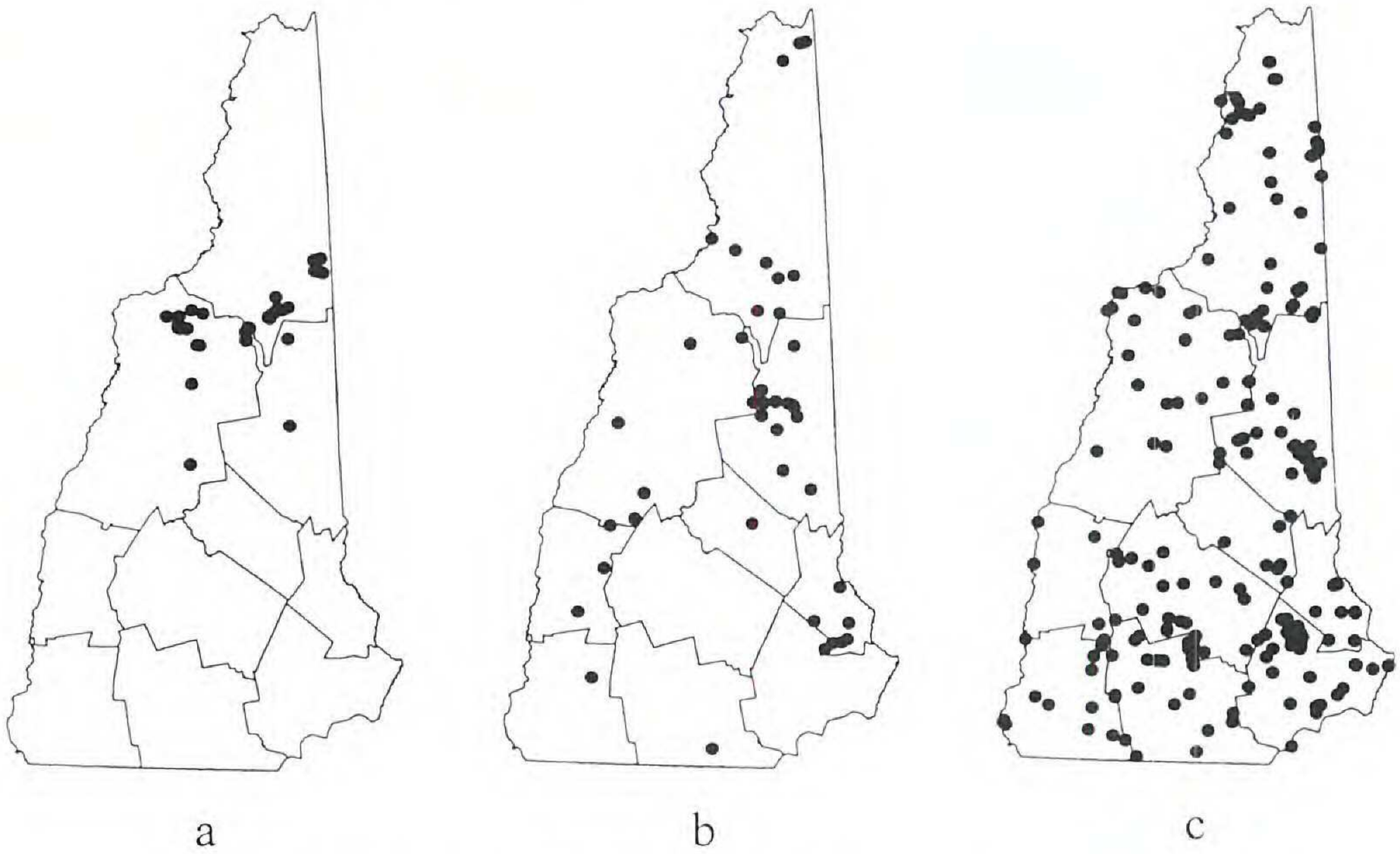

Figure 2. New Hampshire county maps depicting collection site location and intensity over time with a. pre-1900 collection sites; b. 1901–1990 collection sites; c. post 1990 collection sites (two of these sites were not collected by the authors).

Andrews (1906) or Allen (1992). Our collections further added 213 county and 11 state records. Figure 2 depicts the concentration of historical collections in the White Mountain region prior to 1900, the relatively low number of scattered collection sites visited during the subsequent 89 years (1901–1990), and the comparatively even distribution of recent collections.

In the Appendix we have documented forty-three species and two subspecies of *Sphagnum* in New Hampshire. Fifteen species and one subspecies are new state records. These taxa are: *S. andersonianum*, *S. bartlettianum*, *S. brevifolium*, *S. centrale*, *S. compactum*, *S. fallax*, *S. flavicomans*, *S. flexuosum*, *S. henryense*, *S. majus* subsp. *norvegicum*, *S. platyphyllum*, *S. rubellum*, *S. subfulvum*, *S. subtile*, *S. torreyanum*, and *S. viride*.

Species diversity is relatively evenly distributed throughout the counties, with the mountainous Coös, Carroll, and Grafton Counties being the most diverse and Cheshire County the least. Eight species are documented in all counties. The fourteen species reported from nine or more counties likely represent the most common species of *Sphagnum* occurring in the state. Five species are apparently rare in New Hampshire, based on infrequent collection of these species both within New Hampshire and in the nearby

states of New York and Vermont (Andrus 1980; Andrus et al. 1994; McQueen 1992). Two of these species, *S. andersonianum* and *S. brevifolium*, are fairly recent segregates and their apparent rarity may be partly due to earlier collectors overlooking them. Three of the five rare species are restricted to acidic subalpine bogs and fens of the White Mountain subsection.

Collection intensity and diversity within ecoregions indicate that the White Mountain region exhibits the highest diversity with 39 species present (Figure 3; Table 1). In contrast, the North Connecticut River Valley exhibited extremely low *Sphagnum* diversity (7 species), accompanied by few collections, low proportion of surveyed wetland community types, and low total area (Table 1). The Vermont Piedmont, Gulf of Maine Coastal Lowland, and Connecticut Lakes subsections also have relatively low *Sphagnum* species richness (18–20 species) and collection intensity. Of these, only the Connecticut Lakes subsection had *Sphagnum* collections from more than 50% of the wetland community types.

DISCUSSION

Since the Andrews (1906) list of New England Sphagnaceae, there have been many changes in species concepts in this family. For instance, *Sphagnum cymbifolium* Ehrh. (Andrews 1906) likely encompasses specimens of *S. centrale*, *S. henryense*, and *S. palustre*. Although many species in Andrews' (1906) list can be traced to synonymies under the current nomenclature, *S. subnitens* Russow & Warnst. and *S. tenerum* (Austin) Warnst. cannot, and therefore were excluded from our tally of species reported by Andrews from New Hampshire. *Sphagnum subnitens*, as it is understood today, does not occur in eastern North America. Andrews' and Warnstorf's concepts of *S. subnitens* included *Sphagnum* species as varied as *S. angermanicum*, *S. flavicomans*, and *S. subfulvum* (Crum 1984; Andrus pers. obs.). *Sphagnum tenerum* (Austin) Warnst. was misapplied to include not only the current *S. tenerum* Sull. & Lesq., but also forms of *S. capillifolium* and *S. russowii*. We have not seen any specimens of *S. tenerum* from New Hampshire, even though it was reported (by prior taxonomic concepts) on Andrews' (1906) list.

Our *Sphagnum* species concept is narrower than those presented by Crum (1984, 1997), especially within the sections *Acu-*

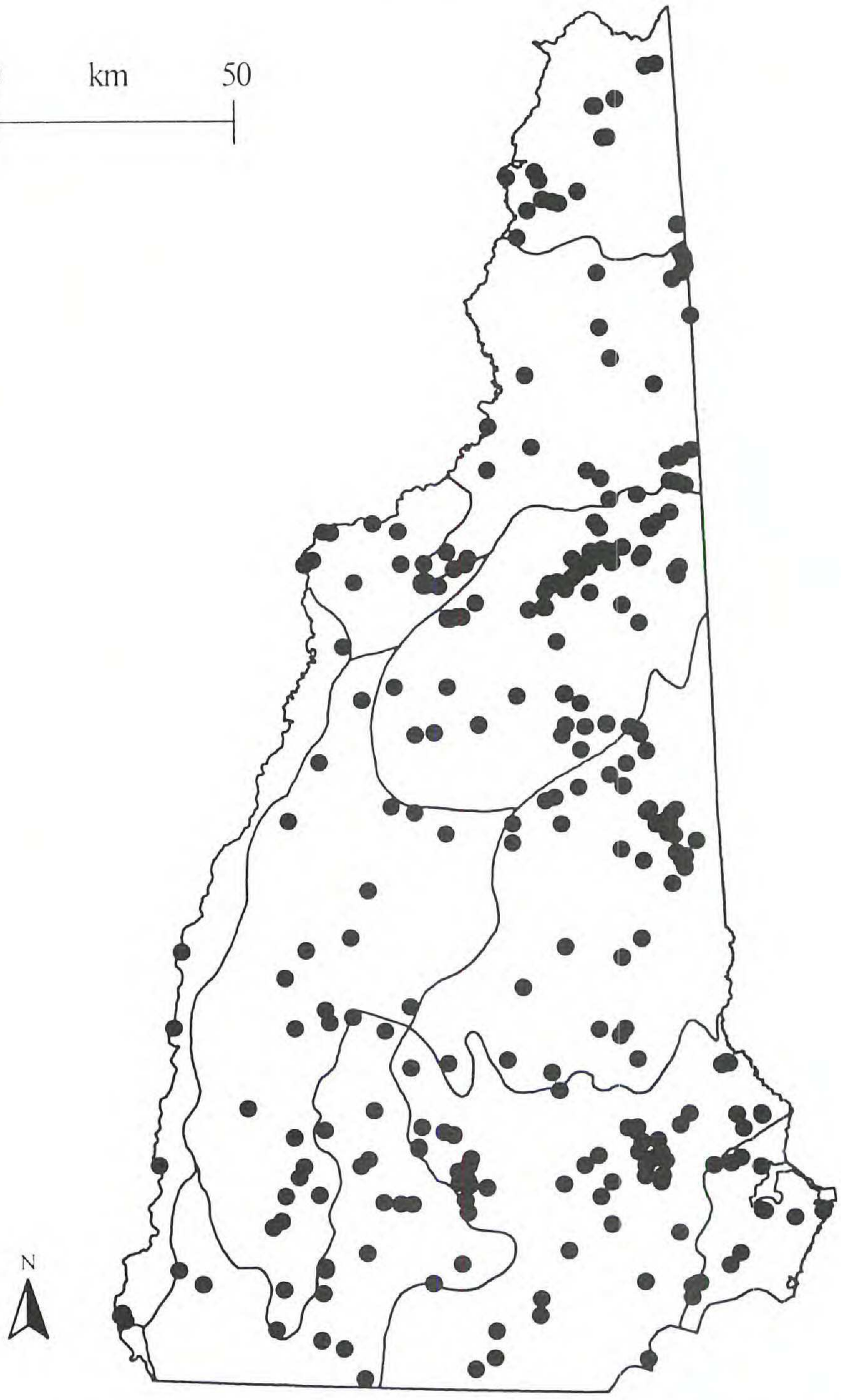

Figure 3. Map of New Hampshire with biophysical subsection outlines showing all known surveyed sites in the state.

tifolia and *Cuspidata*. Employing Crum's (1984, 1997) broader species concept would result in recognition of 34 species and 4 varieties of *Sphagnum* in the state. There are many reasons for being cautious about species delimitation in this genus. For in-

Table 1. Summary of subsection area, wetland diversity, collection intensity, and *Sphagnum* diversity in New Hampshire.

Subsection	Area (km^2)	Wetland Types (primary)	Wetland Types Surveyed	*Sphagnum* Species Documented	Unicate Species Records
Connecticut Lakes	1500	17 (17)	11	19	38
Mahoosuc–Rangeley Lakes	2502	23 (21)	15	31	145
Vermont Piedmont	771	19 (17)	7	18	36
White Mountains	3211	22 (19)	17	39 (1)	269
Northern Connecticut River Valley	1049	19 (13)	3	7	7
Sunapee Uplands	4206	20 (16)	14	29	99
Sebago–Ossipee Hills and Plain	3630	28 (18)	21	34 (1)	323
Hillsborough Inland Hills and Plains	2463	20 (15)	12	26	112
Gulf of Maine Coastal Plain	3678	27 (20)	18	32	351
Gulf of Maine Coastal Lowland	762	24 (18)	10	20	40

stance, Såstad (1999) found that the genetic and phenotypic variability in *S. fallax* and *S. isoviitae* overlapped, and thus did not support a distinction between these two species. In addition to phenotypic plasticity within a species, hybridization has also been reported within section *Acutifolia* (Cronberg 1994). Although we are aware of the problems associated with a narrow species concept, we feel that it is the most appropriate way to report the full diversity of *Sphagnum* species in the state at this time. Continued studies utilizing molecular characters and phenotypic plasticity experiments may lead to the clarification and refinement of *Sphagnum* species circumscription.

New Hampshire ranks sixth highest of the 50 states in *Sphagnum* diversity, even though it is only 44th in size (24,097 km^2). Of the six smaller states, only New Jersey has more species of *Sphagnum* with 46 species currently reported (Andrus et al. 1994). Many New Hampshire sphagna have boreal centers of distribution, while others such as *S. palustre*, *S. henryense*, *S. recurvum*, and *S. bartlettianum* have more southerly distributions.

We attribute New Hampshire's high diversity of *Sphagnum* to the state's high diversity of wetland communities. These communities reflect a broad range of climatic, geologic, and environmental characteristics at the boreal–temperate–coastal interface. By way of comparison, Minnesota, another state at the boreal–temperate transition, has 40 times the wetland area of New Hampshire, but only 30 *Sphagnum* species (Andrus, unpubl. data), probably because it lacks the elevation range and coastal proximity of New Hampshire. Specifically, the presence of calcareous substrates, subalpine peatlands, and a moderately well developed coastal plain contributes significantly to *Sphagnum* diversity within the state compared to other states.

Mosses are often undercollected in comparison to vascular plants, and this has certainly been the case in New Hampshire. In addition, collection of *Sphagnum* by non-experts usually results in large numbers of collections of a limited number of common species (e.g., *S. girgensohnii*), while neglecting the less common though perhaps equally widespread species (e.g., *S. compactum*). Therefore, without additional careful collecting by knowledgeable bryologists, many widespread, but less common species will appear to be more rare than they actually are. For example, Andrus et al. (1992) indicated a number of sphagna as being rare in Alaska based upon herbarium data, but several sub-

sequent collecting trips to the state revealed that nearly all of these apparent rarities were the result of undercollection.

Although it is likely that additional county records will accrue, it seems unlikely that many new state records will be added to this list, since collection efforts have been well distributed within the state. Although collection intensity is not entirely even (Table 1), collection sites include all wetland types and biophysical subsections present in the state (Figure 3). Based on known *Sphagnum* distributions, the most likely species to be found in future searches of the state include *S. annulatum* H. Lindb. *ex* Warnst. and *S. tenellum* (Brid.) Bory. Several coastal species of *Sphagnum* that occur in the bordering states of Maine and Massachusetts also may yet be found in New Hampshire's coastal region. These include *S. austinii* Sull. *in* Austin, *S. molle* Sull., *S. tenerum*, and *S. macrophyllum* Brid.

Natural areas preservation efforts in New Hampshire should integrate information on bryophytes. The distribution of rare peat mosses can be used directly to identify priority wetlands worthy of preservation. In addition, *Sphagnum* and other bryophytes are sensitive indicators of wetland conditions and should be used in the definition and description of community types. This, in turn, will increase the likelihood that representative community types selected for protection will include the full diversity of *Sphagnum* species present in the state and the range of conditions they require for persistence.

The most threatened wetland types in New Hampshire with respect to *Sphagnum* species are rich (calcareous) fens, coastal wetlands, and subalpine wetlands. Sphagna restricted to these wetland types include the rich fen species *S. contortum* and *S. warnstorfii*, the coastal species *S. flavicomans* and *S. torreyanum*, and the subarctic-boreal species *S. lindbergii*. Rich fen species are largely restricted to northern New Hampshire and to calcareous glacial deposits within the Connecticut River watershed. New Hampshire calcareous fens are relatively small (< 1 to 5 ha), and many are former pastures (Sperduto and Gilman 1995). Loss of fens through flooding by beavers and humans, succession to more woody composition, and development are conservation concerns. Almost all of New Hampshire's rich fens are privately owned. New Hampshire's coastal wetlands are threatened by continuing development and accompanying drainage. Subalpine sites need to be guarded against degradation by hikers.

Future survey efforts should focus on several current priorities: 1) verification of historical records, especially for *Sphagnum brevifolium*, to clarify whether or not these species are extant in the state; 2) collection efforts in undercollected geographic areas; and 3) specific surveys for rare peat mosses and surveys in rare community types.

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APPENDIX

CHECKLIST OF *SPHAGNUM* IN NEW HAMPSHIRE

Collection numbers are provided when available, otherwise a comma and a year follow the collector. We have included all numbers from Eaton and Faxon S.B.A. and Faxon N.A.S. that were examined, since these specimens were widely distributed and are widely available for reference. However, more recent collections precede each of the exsiccatae in the list because the exsiccatae specimens were collected over 100 years ago and the species may no longer occur in these historical locations. Species that are known from only two or fewer collection sites are marked with an asterisk.

Habitat comments include general nutrient status, microtopographic position, and peatland types where the species are found in New Hampshire. Habitat comments are informed in part by relationships of *Sphagnum* species to plant communities and pH levels described by Sperduto et al. (2000). Nutrient level terminology corresponds to the following pH ranges: oligotrophic (pH 3.5–4.5), weakly minerotrophic (pH 4–5), moderately minerotrophic (pH 4.5–6), minerotrophic (pH 6–7.3), and strongly minerotrophic (pH 7.3+). Microtopographic terms relate to relative height above the water table. Along the gradient from below the water table and increasing in height from the water table, the terms are: pool, carpet, lawn, hummock side, and hummock top (Vitt 1994).

Sphagnum affine Ren. & Cardot – Weakly to moderately minerotrophic. Carpets and low hummocks in sedge fens, tall shrub fens and thickets, and various swamps including black ash seepage swamps. Belknap *Sperduto 5583c* (BH); Carroll *Sperduto 5502* (BH); Cheshire *Nichols 194* (BH); Coös *Eaton & Faxon S.B.A. 153* (BH); Grafton *Cleavitt 543* (BH), *Faxon N.A.S. 25, 28* (BH); Hillsborough *Cleavitt 939* (BH); Merrimack *Cleavitt 1012* (BH); Rockingham *Cleavitt 966* (BH); Strafford *Cleavitt 965* (BH); Sullivan *Andrus 7669* (BING).

**S. andersonianum* Andrus – Weakly minerotrophic. Low hummocks and hummock sides in very poor ericaceous fens. Grafton *Cleavitt 1519* (BH).

**S. angermanicum* Melin – Weakly minerotrophic. Forms small patches and loose carpets, often intermixed with other *Sphagnum* species in montane and lowland sedge, shrub-graminoid, and dwarf-medium shrub poor fens. Carroll *Andrus 9216* (BING); Grafton *Cleavitt 1517* (BH), *Holcombe 10* (BH).

S. angustifolium (C. Jens. *ex* Russow) C. Jens. *in* Tolf – Oligotrophic to moderately minerotrophic. Carpets and hummock sides, extending far-

ther up hummocks in mixture with hummock-forming *Sphagnum* species, in open carpets, sedge, shrub-graminoid, and dwarf-medium heath shrub fens and bogs. Belknap *Sperduto 4974* (BH); Carroll *Cleavitt 1023* (BH); Cheshire *Nichols 355* (BH); Coös *Cleavitt 1527* (BH); Grafton *Cleavitt 735* (BH), *Eaton & Faxon S.B.A. 110, 111* (BH); Hillsborough *Cleavitt 611* (BH); Merrimack *Nichols 128* (BH); Rockingham *Town NH80* (BING); Strafford *Cleavitt 956* (BH).

S. bartlettianum Warnst. – Oligotrophic to weakly minerotrophic. Carpets and low hummocks in dwarf heath shrub bogs and poor fens. Carroll *Sperduto 5977a* (BH); Cheshire *Nichols 191* (BH); Coös *Sperduto 5900* (BH); Grafton *Sperduto 5724* (BH); Hillsborough *Cleavitt 613* (BH); Rockingham *Andrus 9058* (BING); Strafford *Nichols 060* (BH).

**S. brevifolium* (Lindb. *ex* Braithw.) C. Jens. – Weakly minerotrophic. Carpets mixed with other *Sphagnum* species in poor fens. Coös *Eaton & Faxon S.B.A. 82 in part* (BH).

S. capillifolium (Ehrh.) Hedw. – Oligotrophic to minerotrophic. Dense carpets to tall hummocks in shrub fens and bogs, including exposed alpine and subalpine bogs. Belknap *Sperduto 5600* (BH); Carroll *Cleavitt 1160* (BH); Cheshire *Cleavitt 957* (BH); Coös *Cleavitt 1529* (BH), *Eaton & Faxon S.B.A. 41, 42, 47* (BH); Grafton *Cleavitt 736* (BH); Hillsborough *Cleavitt 971* (BH); Merrimack *Cleavitt 614* (BH); Rockingham *Cleavitt 967* (BH); Strafford *Cleavitt 962* (BH); Sullivan *Nichols 332* (BH).

S. centrale C. Jens. *in* Arnell & C. Jens. – Minerotrophic. Pure carpets and low hummocks in sedge and conifer fens. Carroll *Cleavitt 1161* (BH), *Faxon N.A.S. 47* (BH); Coös *Cleavitt 1030* (BH); Grafton *Cleavitt 1031* (BH); Hillsborough *Sperduto 5584* (BH); Merrimack *Cleavitt 615* (BH); Rockingham *Andrus 9050* (BING); Strafford *Hodgdon, 1956* (NHA); Sullivan *Andrus 7686* (BING).

S. compactum DC. *in* Lam. & DC. – Oligotrophic. In New Hampshire the species is mainly a pioneer and can form dense carpets in seepy places over exposed bedrock, sand, or bare peat. Coös *Pease & Andrews, 1918* (YU); Grafton *Cleavitt 1175, 1522* (BH); Strafford *Sperduto 5839* (BH).

S. contortum Schultz – Moderately to strongly minerotrophic. Loose carpets in constantly moist microsites within calcareous fens and flarks. Belknap *Sperduto 4995b* (BH); Coös *Cleavitt 1431* (BH); Grafton *Cleavitt 1032* (BH), *Eaton & Faxon S.B.A. 138, 139* (BH); Rockingham *Nichols 049* (BH); Sullivan *Andrus 7683* (BING).

S. cuspidatum Ehrh. *ex* Hoffm. – Oligotrophic to weakly minerotrophic. Often with *S. majus* in pools or carpets in open microsites of bogs and poor fens with sparse to dwarf shrub cover. Belknap *Sperduto 5583a* (BH); Carroll *Sperduto 5012* (BH); Cheshire *Nichols 198* (BH); Coös *Sperduto 5753* (BH); Grafton *Cleavitt 529* (BH); Hillsborough *Cleavitt 616* (BH); Merrimack *Cleavitt 617* (BH); Rockingham *Town NH67* (BING); Strafford *Hodgdon & Barrett 15,505* (NHA); Sullivan *Nichols 324* (BH).

S. fallax (Klinggr.) Klinggr. – Oligotrophic to weakly minerotrophic. Often extensive pure carpets and hummock bases in a wide variety of poor fen and bog habitats; absent from alpine bogs. Belknap *Sperduto 4973* (BH); Carroll *Cleavitt 1019* (BH); Cheshire *Nichols 209* (BH); Coös *Cleavitt 1018* (BH); Grafton *Cleavitt 530* (BH); Hillsborough *Cleavitt 618* (BH);

Merrimack *Town NH8* (BING); Rockingham *Andrus 9025* (BING); Strafford *Hodgdon, 1956* (NHA); Sullivan *Andrus 7679* (BING).

S. fimbriatum Wils. *in* Wils. & Hook. f. – Minerotrophic. Low to medium hummocks in sedge and shrub-graminoid fens, tall shrub fens and thickets, and margins of bogs and poor fens. Belknap *Sperduto 4995a* (BH); Cheshire *Nichols 193* (BH); Coös *Andrews, 1917* (BH); Grafton *Cleavitt 531* (BH); Hillsborough *Hodgdon & Roberts 10,025* (NHA); Merrimack *Cleavitt 619* (BH); Rockingham *Town NH30* (BING); Strafford *Cleavitt 963* (BH); Sullivan *Andrus 7668* (BING).

S. flavicomans (Cardot) Warnst. – Oligotrophic to weakly minerotrophic. Medium to tall hummocks in bogs and poor fens. Belknap *Sperduto 5603* (BH); Coös *Austin, 1872* (NY); Rockingham *Town NH85* (BING), *Sperduto 5195* (BH).

S. flexuosum Dozy & Molk. – Oligotrophic to moderately minerotrophic. Carpets in shrub and shrub-graminoid fens and fen margins. Belknap *Sperduto 5588* (BH); Carroll *Sperduto 5791* (BH); Cheshire *Nichols 354* (BH); Coös *Eaton & Faxon S.B.A. 108, 109* (BH); Hillborough *Nichols 271* (BH); Merrimack *Cleavitt 620* (BH); Rockingham *Andrus 9060* (BING); Sullivan *Andrus 7666* (BING).

S. fuscum (Schimp.) Klinggr. – Oligotrophic. Medium to tall dense hummocks in a wide range of habitats, although usually in open microsites and most common in alpine bogs and dwarf to tall shrub fens and bogs. Belknap *Sperduto 5599* (BH); Carroll *Cleavitt 1027* (BH); Coös *Hodgdon 11,539* (NHA); Grafton *Cleavitt 732* (BH), *Eaton & Faxon S.B.A. 33, 34* (BH); Hillsborough *Andrus 9036* (BING); Merrimack *Nichols 151* (BH); Rockingham *Town NH78* (BING); Strafford *Cleavitt 961* (BH); Sullivan *Nichols 333* (BH).

S. girgensohnii Russow – Oligotrophic to minerotrophic. Carpet patches in swamps and wet conifer forest, carpets to low hummocks in alpine bogs, and along the margins of poor sedge fens. Carroll *Cleavitt 1024* (BH); Cheshire *Bechtel 033* (BH); Coös *Cleavitt 1236* (BH), *Eaton & Faxon S.B.A. 1, 5, 7, 9, 10* (BH), *Faxon N.A.S. 24* (BH); Grafton *Cleavitt 532* (BH), *Eaton & Faxon S.B.A. 4, 8* (BH), *Faxon N.A.S. 23* (BH); Hillsborough *Nichols 019* (BH); Merrimack *Cleavitt 622* (BH); Rockingham *Cleavitt 968* (BH); Strafford *Hodgdon 12,252* (NHA); Sullivan *Andrus 7676* (BING).

S. henryense Warnst. – Weakly to moderately minerotrophic. Low to medium hummocks in a variety of shrub, sedge, and shrub-graminoid poor to intermediate fen and swamp habitats. Belknap *Cleavitt 1512* (BH); Carroll *Andrus 9255* (BING); Cheshire *Cleavitt 928* (BH); Coös *Bartlett 1210* (BH); Grafton *Cleavitt 1524* (BH); Hillsborough *Cleavitt 940* (BH); Merrimack *Cleavitt 623* (BH); Rockingham *Cleavitt 624* (BH); Strafford *Hodgdon 12,251* (NHA); Sullivan *Andrus 7670* (BING).

S. inundatum Russow – Weakly minerotrophic. Thick carpets in poor to intermediate fens. Belknap *Sperduto 5595* (BH); Carroll *Andrus 9230* (BING); Grafton *Sperduto 4253* (BH); Hillsborough *Cleavitt 937* (BH); Rockingham *Town NH53* (BING); Sullivan *Andrus 7682* (BING).

S. isoviitae Flatberg – Oligotrophic to weakly minerotrophic. Carpets in a wide range of open microsites in poor to intermediate fens. Belknap

Sperduto 5471 (BH); Carroll *Sperduto 5027* (BH); Coös *Sperduto 5757* (BH); Grafton *Sperduto 4923* (BH), Hillsborough *Nichols 372* (BH); Merrimack *Cleavitt 625* (BH); Rockingham *Andrus 9025* (BING); Strafford *Nichols 061* (BH); Sullivan *Nichols 329* (BH).

S. lescurii Sull. *in* Gray – Weakly to moderately minerotrophic. Ruderal species found in a wide range of habitats, particularly habitats with fluctuating water levels, mostly in sprawling patches in rock seeps and lake and streamside sedge or shrub-graminoid fens. Belknap *Carter, 1902* (BH); Carroll *Cleavitt 1169* (BH); Cheshire *Nichols 197* (BH); Coös *Sperduto 5185* (BH); Grafton *Cleavitt 1405* (BH), *Eaton & Faxon S.B.A. 145, 146* (BH); Hillsborough *Cleavitt 938* (BH); Merrimack *Cleavitt 627* (BH); Rockingham *Town NH57* (BING); Sullivan *Andrus 7682* (BING).

**S. lindbergii* Schimp. *in* Lindb. – Weakly minerotrophic. Carpets in high elevation heath balds and alpine bogs. Coös *Cleavitt 1220* (BH), *Eaton & Faxon S.B.A. 82, 83* (BH).

S. magellanicum Brid. – Oligotrophic to weakly minerotrophic. Carpets and hummocks in a wide variety of peatlands, especially common in open dwarf to tall shrub fens and bogs and conifer fens. Belknap *Sperduto 5601* (BH); Carroll *Cleavitt 1022* (BH); Cheshire *Nichols 196* (BH); Coös *Cleavitt 1530* (BH), *Faxon N.A.S. 28, 33* (BH); Grafton *Cleavitt 1359* (BH), *Faxon N.A.S. 29, 35* (BH); Hillsborough *Cleavitt 628* (BH); Merrimack *Nichols 109* (BH); Rockingham *Town NH58* (BING); Strafford *Hodgdon & Barrett 15,503* (NHA); Sullivan *Fujiyama, 1918* (BH).

S. majus (Russow) C. Jens. subsp. *majus* – Oligotrophic. Pools and lawns in very poor fens and bogs. Carroll *Sperduto 5499* (BH); Grafton *Eaton & Faxon S.B.A. 101* (BH); Hillsborough *Sperduto 4901* (BH); Rockingham *Sperduto 4915* (BH); Strafford *Sperduto 5702a* (BH).

S. majus subsp. *norvegicum* Flatberg – Weakly minerotrophic. Lawns in poor sedge fens and pond margins. Carroll *Andrus 9214* (BING); Coös *Eaton and Faxon S.B.A. 100* (BH); Grafton *Cleavitt 1511* (BH).

S. palustre L. – Weakly to moderately minerotrophic. Carpets and hummocks in fens and swamps. Belknap *Sperduto 5481* (BH); Carroll *Cleavitt 1156* (BH); Cheshire *Bechtel 034* (BH); Coös *Sperduto 4871* (BH); Grafton *Sperduto 4924a* (BH); Hillsborough *Andrus 9035* (BING); Merrimack *Allen 10,046* (MO); Rockingham *Cleavitt 629* (BH); Strafford *Cleavitt 964* (BH); Sullivan *Nichols 334* (BH).

S. papillosum Lindb. – Weakly minerotrophic. Thick carpets and low hummocks in open microsites in dwarf to medium heath shrub fens. Belknap *Sperduto 5587* (BH); Carroll *Sperduto 5856a* (BH); Cheshire *Nichols 228* (BH); Coös *Cleavitt 1407* (BH); Grafton *Cleavitt 734* (BH), *Eaton & Faxon S.B.A. 163* (BH); Hillsborough *Cleavitt 597* (BH); Merrimack *Nichols 378* (BH); Rockingham *Town NH28* (BING); Strafford *Cleavitt 914* (BH).

S. platyphyllum (Lindb. *ex* Braithw.) Sull. *ex* Warnst. – Weakly to moderately minerotrophic. Often found in sprawling patches alongside *S. lescurii* on shores of ponds and lakes, along streams, and margins of sedge or shrub-graminoid fens. Carroll *Andrus 9229* (BING); Hillsborough *Cleavitt 937* (BH); Rockingham *Nichols 033* (BH), *Town NH25* (BING).

S. pulchrum (Lindb. *ex* Braithw.) Warnst. – Oligotrophic to weakly minerotrophic. Often forming floating mats but also in lawns or carpets in poor

fens among sedges and usually with sparse or dwarf shrub cover. Belknap *Sperduto 5474b* (BH); Carroll *Cleavitt 1157* (BH); Coös *Faxon N.A.S. 49* (BH); Grafton *Sperduto 5726* (BH); Hillsborough *Nichols 278* (BH).

S. pylaesii Brid. – Oligotrophic to weakly minerotrophic. Growing in prostrate to somewhat erect mats over rock or submerged in fen pools. Carroll *Farlow Reliquiae Farlowianae 547* (BH); Grafton *Cleavitt 1518* (BH), *Faxon N.A.S. 35, 39* (BH); Strafford *Sperduto 4909b* (BH).

S. quinquefarium (Lindb. *ex* Braithw.) Warnst. – Weakly minerotrophic. Carpets in conifer fens and over rock or mineral soil at higher elevations. Coös *Andrews, 1917* (BH), *Sperduto 5510* (BH); Grafton *Cleavitt 652* (BH), *Eaton & Faxon S.B.A. 36, 37, 39* (BH), *Faxon N.A.S. 39, 43* (BH).

S. recurvum P. Beauv. – Weakly minerotrophic. Carpets in various poor fen habitats, typically at margins of peatlands including lagg and pond border situations. Belknap *Sperduto 5493* (BH); Carroll *Cleavitt 1028* (BH); Cheshire *Cleavitt 919* (BH); Coös *Cleavitt 1270* (BH); Hillsborough *Cleavitt 631* (BH); Merrimack *Sperduto 6079* (BH); Rockingham *Cleavitt 630* (BH); Strafford *Nichols 103* (BH).

S. riparium Ångstr. – Weakly minerotrophic. Lawns at the margins of bogs and poor fens. Belknap *Sperduto 5220* (BH); Carroll *Sperduto 5016* (BH); Coös *Cleavitt 1520* (BH), *Eaton & Faxon S.B.A. 86, 87* (BH), *Faxon N.A.S. 45, 46* (BH).

S. rubellum Wils. – Oligotrophic to weakly minerotrophic. Dense carpets (often floating) to low hummocks in open dwarf to medium heath shrub bogs and poor fens. Belknap *Sperduto 5605* (BH); Carroll *Cleavitt 1171* (BH); Cheshire *Nichols 195* (BH); Coös *Sperduto 4880* (BH); Grafton *Cleavitt 586* (BH); Hillsborough *Cleavitt 632* (BH); Merrimack *Town NH5* (BING); Strafford *Sperduto 4906* (BH); Sullivan *Nichols 321* (BH).

S. russowii Warnst. – Oligotropic to minerotrophic. Carpets and hummock sides, often mixed with other species in poor shrub fens, alpine and subalpine bogs, and wet sites in conifer forests. Belknap *Sperduto 5583b* (BH); Carroll *Cleavitt 1021* (BH); Coös *Cleavitt 1020* (BH), *Faxon N.A.S. 55, 56* (BH); Grafton *Cleavitt 581* (BH), *Eaton & Faxon S.B.A. 19* (BH); Hillsborough *Cleavitt 971* (BH); Merrimack *Quillinan 94-101-35* (BH); Rockingham *Cleavitt 633* (BH); Strafford *Sperduto 5710* (BH).

S. squarrosum Crome – Moderately minerotrophic. Carpets in conifer fens, at margins of poor fens, and in seepage swamps, forest seeps and other shady, moist situations. Carroll *Sperduto 5015* (BH); Coös *Engstrom, 1996* (BH), *Eaton & Faxon S.B.A. 67, 69, 70, 71* (BH); Grafton *Cleavitt 1406* (BH), *Faxon N.A.S. 53, 59, 60* (BH); Hillsborough *Cleavitt 969* (BH); Merrimack *Cleavitt 634* (BH); Rockingham *Sperduto 5342* (BH); Strafford *Hodgdon 14,594* (NHA); Sullivan *Andrus 7680* (BING).

**S. subfulvum* Sjørs – Strongly minerotrophic. Hummocks in open sites in intermediate to rich fens. Sullivan *Andrus 7667, 7671* (BING).

S. subsecundum Nees *in* Sturm – Minerotrophic. Carpets to low hummocks along open margins of poor fens. Belknap *Sperduto 5590* (BH); Carroll *Sperduto 5494a* (BH), *Faxon N.A.S. 67* (BH); Coös *Eaton & Faxon S.B.A. 128, 135* (BH); Grafton *Eaton & Faxon S.B.A. 133, 136* (BH); Sullivan *Andrus 7685* (BING).

S. subtile (Russow) Warnst. – Oligotrophic to weakly minerotrophic. In low

hummocks in shaded microsites of poor conifer fens and bogs, including montane sloping fens. Carroll *Andrus 9243* (BING); Coös *Sperduto 4877* (BH); Grafton *Cleavitt 1528* (BH); Merrimack *Nichols 131* (BH); Rockingham *Town NH16* (BING); Sullivan *Andrus 7677* (BING).

S. teres (Schimp.) Ångstr. *in* Hartm. – Moderately to strongly minerotrophic. Carpets to hummocks in intermediate to rich fens and seepage forest. Carroll *Andrus 9267* (BING); Coös *Cleavitt 1029* (BH); Grafton *Cleavitt 737* (BH); Sullivan *Andrus 7680* (BING).

S. torreyanum Sull. – Weakly minerotropic. Pools or lawns in poor fens with sparse and dwarf shrub cover or submerged along lake margins. Belknap *Sperduto 5604* (BH); Carroll *Cleavitt 1344* (BH); Cheshire *Nichols 230* (BH); Coös *Sperduto 5896* (BH); Hillsborough *Sperduto 5610* (BH), *Cherrington, 1904* (BH); Merrimack *Town NH2* (BING); Rockingham *Cleavitt 635* (BH); Sullivan *Nichols 330* (BH).

S. viride Flatberg – Weakly minerotrophic. Pools and lawns in poor fens. Carroll *Cleavitt 1026* (BH); Hillsborough *Andrus 9031* (BING); Merrimack *Town NH12* (BING); Rockingham *Andrus 9029* (BING).

S. warnstorfii Russow – Moderately to strongly minerotrophic. Carpets and hummocks in open calcareous sedge fens, seepage swamps, and other minerotrophic fen and swamp situations. Carroll *Sperduto 5768* (BH); Coös *Sperduto 4392* (BH); Grafton *Sperduto 4391* (BH), *Eaton & Faxon S.B.A. 23, 28* (BH).

S. wulfianum Girg. – Minerotrophic. Carpets and loose hummocks in shady microsites of treed fens and moist conifer forests of central and northern New Hampshire. Carroll *Sperduto 6191* (BH); Coös *Cleavitt 985* (BH), *Eaton & Faxon S.B.A. 73* (BH); Grafton *Sperduto 6192* (BH), *Eaton & Faxon S.B.A. 74, 75* (BH).